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ABSTRACT

This manual was written to provide basic information on the metric system for Kentucky teachers. Why we are going metric is briefly discussed, followed by a concise presentation of metric measures. What children should learn is specified in terms of competencies for grades 3, 6, and 9. Teaching tips are presented, with activities for use with children. Inferences for five other curricular areas are noted. A list of 19 useful materials is also included. (MS)

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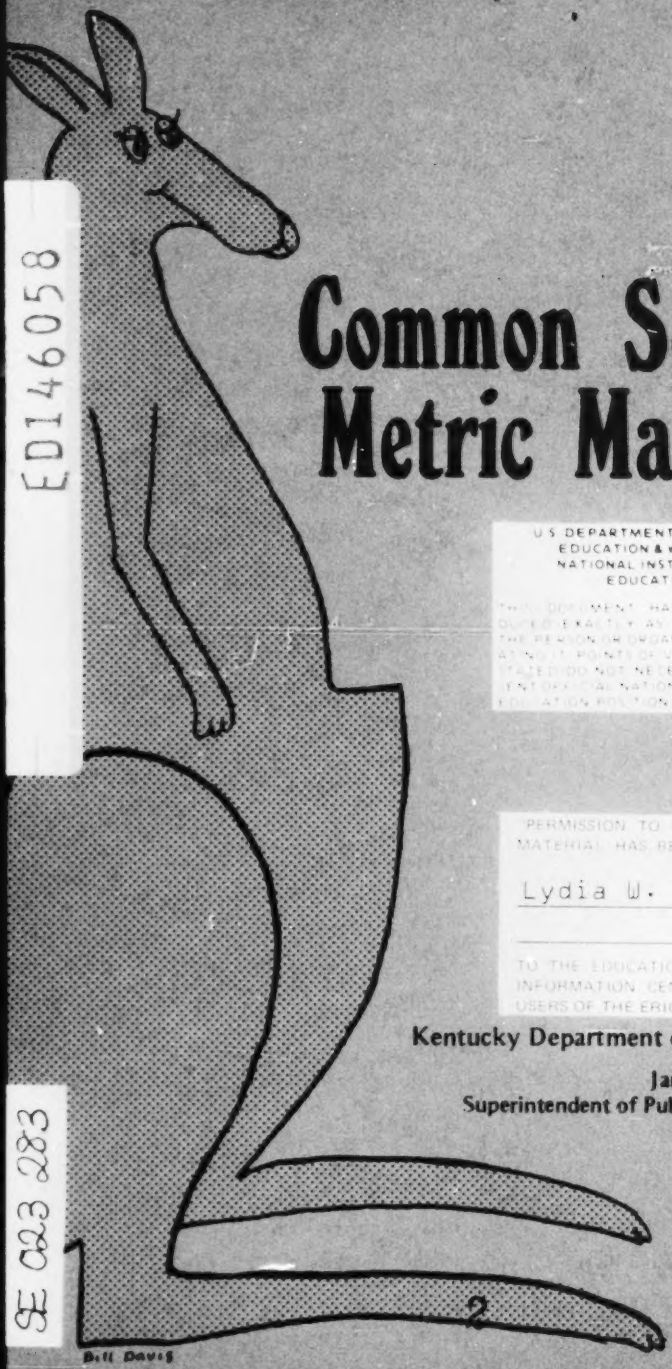

The Common Sense Metric Manual

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1977

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The Common Sense Metric Manual

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Foreword

This manual was written for the Kentucky teachers who have been called upon to teach the metric system. (The official title is "The International System of Units" or "SI," but we'll simply call it the metric system.)

Many teachers panic when they learn that the Kentucky State Board of Education resolved that the metric system must be introduced by the 1976-77 school year and must be the predominant system of measurement in the schools by 1980-81.

The Common Sense Metric Manual was designed to help relieve that panicky feeling.

We realize that every teacher cannot enroll in a crash course and become a metric expert by these deadlines; hence, this do-it-yourself booklet. By combining the ideas in this manual with the skills and common sense every good teacher has, the metric system can be mastered.

It may require much more extensive study to become a metric expert; but studying this manual and putting its ideas into practice should lead to an appreciation of the finer points of the system, familiarity with its basic structure, and the competence and confidence to begin teaching it to students.

Acknowledgements

We would like to thank everyone who has contributed ideas, time, suggestions, and criticism to this effort. We would especially like to express our appreciation to:

- –Teachers throughout the state who have participated in our metric workshops and made many helpful comments and suggestions;
- –Kentucky educators who are concerned about an orderly transition to metrics and who have contributed many ideas incorporated in this booklet;
- –Louise Quinn of Morehead State University who has been a long-time proponent of the metric system in business education;
- –Lois Adams of the Bureau of Education for Exceptional Children for her contribution concerning metrics for exceptional children;
- –Doug Lorenz of the Bureau of Vocational Education for his contribution concerning metrics in industrial education;
- –Helen Shryock of the Bureau of Vocational Education for her contribution concerning metrics in home economics;
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Why we are going metric

Almost everybody outside the United States uses the metric system—and now we will also. In December of 1975 President Ford signed a bill initiating a 10-year changeover to the metric system. Soon we will buy milk by the litre, fabric by the metre, and hamburger by the kilogram.

Although we are changing to metrics because almost everyone else uses the metric system, there are characteristics of the system which also are good reasons for changing. The chart below emphasizes those characteristics.

The Metric System	The English System
1. It was logically planned.	1. It arose haphazardly.
2. The units are scientifically based.	2. The units are based on human standards—for example, the length of a king's foot.
3. Calculations are easy since units are related by 10's—10, 100, 1000, etc.	3. Calculations are complex since units are not related by a single number—12 inches make a foot but 3 feet make a yard, etc.
4. Units for length, volume, and mass (weight) are interrelated—for example, 1 cubic centimetre of water has a mass of 1 gram.	4. No convenient relationship exists among units for length, volume, and mass (weight)—for example, 1 cubic inch of water has a mass of about 0.036 pounds.
5. There are only 7 basic units. Names of other units are formed by simply adding prefixes.	5. There are more than 50 basic units with unrelated names.

A quick introduction to the Metric System

Figures 1 and 2 will help you follow the next few paragraphs.

Length

The basic unit of length in the metric system is the metre. A metre is about the distance most doorknobs are from floors. Larger and smaller units are created by simply multiplying or dividing by powers of 10—10, 100, 1000, etc. For example, a centimetre is the unit created when a metre is divided into 100 equal parts.

Area

A unit of area is created by simply making a square with sides equal to one of the length units—for example, a square centimetre, a square decimetre.

Volume

Similarly, a unit of volume is created by making a cube with sides equal to one of the metric lengths—for example, a cubic centimetre, a cubic decimetre. Two different but equivalent sets of terms are then used for indicating volume. The equivalent terms are:

1 cubic metre = 1 kilolitre
1 cubic decimetre = 1 litre
1 cubic centimetre = 1 millilitre

Use whichever set of terms is most convenient. When the capacity of a teaspoon is being considered, for example, the term millilitres is often used. As a simple reference point, the volume of a teaspoon is 5 millilitres or 5 cubic centimetres.

Mass

Mass is what is commonly called weight in the customary system. A unit of mass is created by filling a metric volume container with water and then considering the mass of the water that was used. For example, the amount of water required to fill a cubic centimetre container is said to have a mass of 1 gram. Thus, since a teaspoon of water has a volume of 5 cubic centimetres, that same teaspoon of water has a mass of 5 grams.

Another unit of mass is the kilogram, which is the mass of a cubic decimetre of water. A convenient reference point for kilograms is the mass of a quart of milk; it is a little less than 1 kilogram.

Figure 1

SOME COMMON UNITS (AND SOME OF THEIR MULTIPLES)
IN THE METRIC SYSTEM

LENGTH	AREA	VOLUME (CAPACITY)	MASS
kilometre	square kilometre	cubic kilometre	
hectometre	square hectometre = hectare	cubic hectometre	
dekametre	square dekametre = are	cubic dekametre	
metre	square metre = centiare	cubic metre = kilolitre	megagram = tonne
decimetre	square decimetre	cubic decimetre = litre	kilogram
centimetre	square centimetre	cubic centimetre = millilitre	gram
millimetre	square millimetre	cubic millimetre	milligram

1. Units underlined twice are the basic units.

2. Units underlined once or twice will be used by almost everyone. The other units are rarely used and it is less important that children learn about them.

3. The "are" and "hectare" (see AREA) are now in use but will be abandoned in the near future.

Temperature

Units of temperature are based on the freezing and boiling points of water. The freezing point of water is designated as 0 degrees Celsius and the boiling point of water as 100 degrees Celsius. On the Celsius scale, the temperature of a comfortable room is about 20°C. This scale for temperatures was previously called "centigrade."

Figure 1 and Figure 2 give additional information about some of the metric units and the prefixes.

Figure II

MEANING OF PREFIXES
(FOR SOME UNIT IN THE SYSTEM

megaUNIT	UNIT X 1 000 000
kiloUNIT	UNIT X 1 000
hectoUNIT	UNIT X 100
dekaUNIT	UNIT X 10
UNIT	UNIT X 1
deciUNIT	UNIT X 1/10
centiUNIT	UNIT X 1/100
milliUNIT	UNIT X 1/1000

Replace UNIT with METRE when measuring length, LITRE for volume, or GRAM for mass.

What children should learn

The following metric competency goals are suggested as a basic guide for planning instructional programs and were developed by the National Council of Teachers of Mathematics (NCTM) Metric Implementation Committee and approved by the NCTM Board of Directors. Comments pertaining to the implementation of these goals in Kentucky are in small print.

Third-Grade Competencies

By the end of the third grade (age 9), students should be able to:

1. Identify the centimetre and metre as units of linear measure; identify the kilogram as a unit of weight (mass) measure; and identify the litre as a unit of volume (liquid) measure.

*A decimetre is such a convenient size for primary children that it should be used in measuring even before centimetres are used.

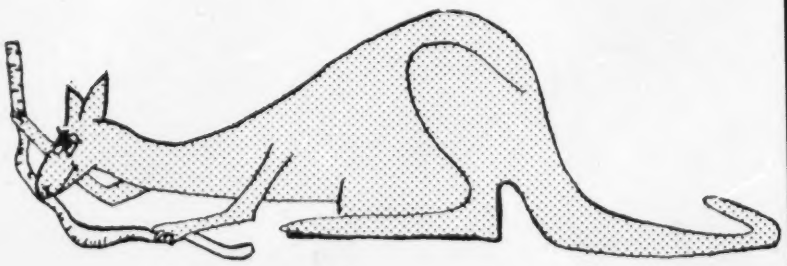
2. Distinguish between models of the metre and the centimetre.
3. Use a centimetre ruler (without millimetre markings) to measure line segments and linear objects to the nearest centimetre, and to draw a line segment having a given measure in centimetres to the nearest centimetre.
4. Identify the unit name associated with each of the symbols cm, m, kg, *l* (but not necessarily reverse the process).
5. Find the weight (mass) of an object to the nearest kilogram.
6. Distinguish a litre model from another capacity model at least 50 percent larger or smaller, and use a litre container to measure the volume of a liquid or granular substance.
7. Read a temperature (positive, zero, and negative) from a Celsius scale thermometer to the nearest degree; and identify a zero Celsius temperature as "freezing" and a negative Celsius temperature as "below freezing."

Sixth-Grade Competencies

At the end of the sixth grade (age 12), students should be able to:

1. Select a unit model for each of the units metre, decimetre, centimetre, litre, and kilogram; and measure lengths to the nearest whole number of millimetres.

*The use of millimetres is usually appropriate for sixth grade and above.



2. Use a metrestick (or other rule) with millimetre markings to measure line segments and linear objects to the nearest tenth of a centimetre, tenth of a decimetre, and tenth of a metre; use the kilometre to describe experience-related travel distances; and apply the following equivalencies.

10 mm = 1 cm
100 cm = 1 m
10 cm = 1 dm
1000 mm = 1 m
10 dm = 1 m
1000 m = 1 km

*Students should determine these equivalencies by comparing a ruler marked in centimetres, for example, with a ruler marked in millimetres. The equivalencies should not be committed to memory without these comparison activities.

3. Make a direct reading of weight (mass) measure of an object to the nearest tenth of a kilogram from a scale; read the measure of liquid or granular substance in a graduated container to the nearest ten millilitres.

4. State applications for each metric unit with which they have basic familiarity, from areas such as commerce, industry, science, and the arts.

5. Identify the unit name associated with each of the symbols mm, cm, dm, m, km, g, kg, m*l*, *l*, and °C and, in most cases, reverse the process.

6. State that the linear dimensions of the standard model of a square centimetre and a cubic centimetre are 1 cm by 1 cm and 1 cm by 1 cm by 1 cm, respectively; make a similar statement for the dimensions of the standard models of a square metre and a cubic metre.

*Have students select unit models for square centimetres, square decimetres, square metres, cubic centimetres, cubic decimetres, and cubic metres.

*Area is best taught by having students cover various surfaces with units of surface measure such as cm^2, and then counting the number of units used. Students should be able to select appropriate units for area measurement as well (e.g. use cm^2 to measure the area of a dollar bill—not m^2.)

7. Recognize and apply the following relationships:

1 metre is a little more than a yard;

1 kilometre is a little more than ½ mile;

1 kilogram is a little more than 2 pounds;

2.5 cm is about 1 inch; and

1 litre is a little more than 1 quart.

This is the extent of conversions between the two systems recommended for the interim changeover period.

*These comparisons are intended to give students a feeling for the size of the units and are *not* to be used to convert customary units to metric units or vice versa.

8. Relate 0°C and 100°C to the freezing and boiling temperatures of water; identify 37°C as "normal" body temperature; and identify temperatures in the human "comfort zone" (about 22°C to 25°C).

9. Estimate distances up to 5 metres in whole metres and lengths up to 10 centimetres in whole centimetres

*Estimations should be made by comparing personal body references (e.g. the width of the little finger) with the length of the object to be estimated. It is not necessary to limit estimated distances to less than 5 m or 10 cm.

10. Estimate volumes up to 5 litres in whole litres and estimate 250 millilitres (approximately 1 cup).

*It is appropriate at this level to estimate in millilitres various capacities up to 1 litre.

11. Compute sums and differences of measures expressed in decimal form such as:

$$\begin{array}{r} 1.36\ \text{m} \\ +2.49\ \text{m} \\ \hline 3.85\ \text{m} \end{array} \qquad \begin{array}{r} 4.200\ l \\ -1.600\ l \\ \hline 2.600\ l \end{array}$$

12.* Express personal heights in centimetres and personal weights (mass) in kilograms.

*Have students complete objective number 12 by the end of grade 3.

Ninth-Grade Competencies

By the end of the ninth grade (age 15) students should be able to:

1. Arrange in a greater-to-less sequence the prefixes kilo-, hecto-, deka-, (unit), deci-, centi-, and milli- and relate them to the multiplication constants 1000, 100, 10, (1), 0.1, 0.01, 0.001; and read lengths directly from a metrestick or metric tape as decimal measures—for example, 37.5 cm for 375 mm length, or 2.55 m for 255 cm length.

2. Select the appropriate type of unit for a given measurement situation, such as linear unit for length, volume unit for volume, weight (mass) unit for weight (mass); and select a convenient size unit for similar situation.

3. Convert from one unit to a larger (or smaller) unit of the same type. For example:

   136 cm = 1.36 m; 25 m = .025 km

4. Relate square centimetre, cubic centimetre, square metre, cubic metre, square millimetre, and cubic millimetre to their respective symbols (cm^2, cm^3, m^2, m^3, mm^2, mm^3).

5. Identify the litre as a special name for 1 cubic decimetre (and also for 1000 cubic centimetres); identify 1 cubic centimetre and 1 millilitre as equivalent; and rename 1000 kilograms as 1 tonne (1 t) and vice versa.

6. Estimate distances up to 100 metres in multiples of 10 metres, and estimate distances up to 100 centimetres in multiples of 10 centimetres.

7. Use referents for varying amounts of weight (mass), such as a paper clip (about 1 g), a litre of milk (about 1 kg), or personal weight (mass—perhaps 50 kg); and give a meaningful referent for 1 kilometre.

8. Convert a combination measurement expression to a decimal multiple of one of the two units used such as:

   1 m 34 cm = 1.34 m or 134 cm

   1 *l* 300 m*l* = 1.300 *l* or 1300 m*l*

*Measurement recorded as 3m 6cm 7cm are rarely appropriate and should be expressed instead as 3.67 m, or 36.7 dm, or 367 cm.

9. Convert from smaller to larger (or larger to smaller) square and cubic units, such as:

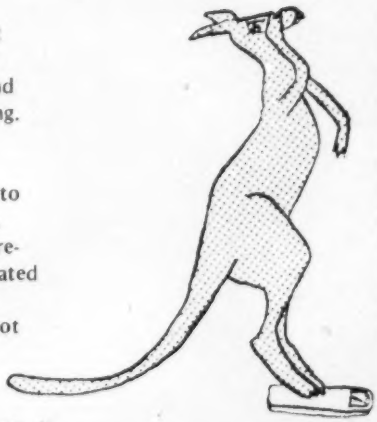
   3000 cm^2 = 0.3 m^2 and 7500 mm^3 = 7.5 cm^3

Teaching Tips

GET INVOLVED
Use an activity approach as opposed to lecture or paper and pencil methods. Children learn a measurement system best through active involvement.

FIND HANDY REFERENTS
Have students find parts of their bodies or items in their classroom which are about the size of the various units in the metric system.

ESTIMATE
Estimation is an important component of measurement skills. Have children estimate the measurements of items and then check their estimates by measuring.



TAKE IT EASY
It is neither necessary nor appropriate to teach the entire metric system at once. It may be introduced whenever measurement is used in the classroom. An isolated group of lessons on the metric system without subsequent reinforcement is not very effective.

ONE SYSTEM AT A TIME
Measuring instruments should be labeled exclusively in metric units for measuring activities.

HOW TO START
An appropriate sequence for teaching any type of measurement to children would be:

a. comparing objects (e.g. Is Mary taller than Fernando?)

b. comparing objects with nonstandard units (e.g. The mass of an eraser is how many pennies?)
c. comparing objects and metric units (e.g. The area of the floor of the gerbil cage is how many square centimetres?)
d. choosing appropriate metric units for specific tasks (e.g. Would you use litres or millilitres in determining the amount of water in an aquarium?)

STICK WITH THE BASICS

Most measurement should deal only with the common units: centimetre, decimetre, metre, kilometre, square centimetre, square decimetre, square metre, gram, kilogram, millilitre, litre.

RELATE

Initially it may be appropriate to relate basic metric units to customary units. For example, if a student knows how large a quart is, then having him compare a litre with a quart will provide him with a useful referent for litres. Similar comparisons may be made for metres and yards, kilograms and pounds.

DON'T CONVERT

It is not appropriate to have students convert customary units to metric units or vice versa. Problems such as 6 inches = ____ centimetres are not beneficial. Such conversions, if necessary, can be done easily with charts or calculators.

THINK METRIC

Teach students to "Think Metric." Learning to "Think Metric" is much easier than trying to "Think English Units, Then Convert."

BE REASONABLE

Artificial precision in metric measures (usually the result of using conversion factors) should be avoided. A waist measurement of 32 inches does not become 81.28 cm (32 x 2.54); it becomes 81 cm.

USE DECIMALS

Fractions are generally inappropriate with metric measures. Decimals should be used. Write 47.4 cm, not 4 2/5 cm.

DON'T MIX UNITS

Forms such as 3 m 6 dm 7 cm are rarely appropriate. Instead write 3.67 m or 36.7 dm or 367 cm.

USE CORRECT SYMBOLS

Metric units have shortened forms called symbols.

centimetre – cm	litre – l
decimetre – dm	millilitre – ml
metre – m	gram - g
kilometre – km	kilogram – kg

Symbols for area and volume units are created by using the linear symbol plus a superscript 2 or 3; (e.g. square centimetre is written cm^2, not sq. cm, and cubic decimetre is written dm^3, not cu. dm.)

THAT SILLY MILLIMETRE

Rulers divided into millimetres are usually not appropriate until about the sixth grade.

TAKE YOUR CHOICE

The names for units in the metric system may end in either "-re" or "-er" (e.g. metre or meter)

MASS/WEIGHT

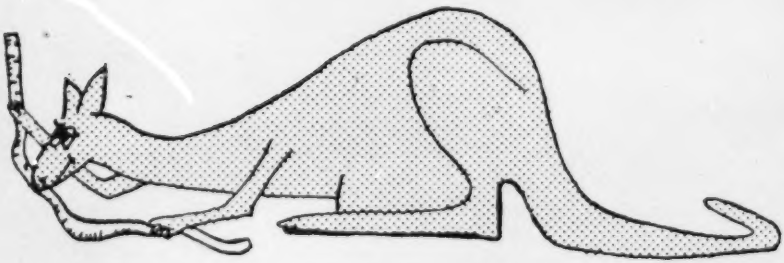
Technically speaking there is a distinction between mass and weight which may be middle school and high school students. Mass is the quantity of matter an object contains; weight is the pull on an object by another object – usually the earth. A spaceman's mass would not change wherever he traveled, but his weight wo would be different on each planet.

TEST THE SAME WAY YOU TEACH

Since an activity approach is used in teaching metrics, an activity approach should be used in testing students on metrics. For example, have students estimate the measurements of selected objects, choose the appropriate unit to be used in measuring certain items, and choose the most reasonable measurement for an object from several possible answers.

HOW CLOSE IS CLOSE?

It would be reasonable to accept extimates of length if they are correct within 10%, area within 20%, volume within 30%, and mass within 40%.



Activities to do with children

The emphasis throughout these activities is on active student involvement.

Length

1. Find things in the classroom which measure about 1 m; 1 dm; 1 cm.
2. Find parts of your body which measure about 1 m; 1 dm; 1 cm.
3. Cover a decimetre strip with centimetres. How many does it take? Repeat with dm and m; cm and m.
4. Have students find points on their bodies which are 1 m from the floor. How many foot-lengths does it take to equal 1 m? From the tip of a student's finger along his outstretched arm to what point on his body is 1 m?
5. Have students find items at home which are examples of 1 m, 1 cm, and 1 dm. Ask them to tell their parents what they are doing.
6. Have students find their heights in centimetres. Repeat throughout the school year and have each child make a graph of his results.
7. Have students find their measurements in centimetres. For example, which student has the largest smile?
8. Play scavenger hunt. Measure 6 or 8 items in the room but write down only their lengths. Have students find the items just from knowing the given lengths.
9. Have estimating contests. Students use the parts of their bodies which are examples of 1 cm, 1 dm, and 1 m to estimate the lengths of selected items. Then check estimates. Repeat occasionally during the year. An estimate within 10% is very good.
10. Measure the school hallway or driveway in metres. Determine how many times back and forth would equal a kilometre.

Area

1. Draw shapes, both regular and irregular ones, on square centimetre graph paper. Have students count (sometimes they will need to approximate) the number of squares inside each shape. This concept is the essence of area.

2. Have students cover shapes—e.g. dollar bills, index cards, envelopes, half dollars—with centimetre squares. About how many does it take? The answer is the area.
3. Lay a clear plastic square centimetre grid sheet on top of shapes and figure out the areas.
4. Cut squares which are 1 dm by 1 dm. Use these squares to cover bigger surfaces such as desks, records, etc.
5. Lay a sheet of clear plastic square centimetre paper on top of a square decimetre. How many square centimetres in 1 square decimetre?
6. Have students draw many rectangles on square centimetre graph paper. Have them count the areas of each. Then guide them to discover the multiplication rule for finding areas of rectangles.
7. Find the areas of floors and walls in square metres. Cut a piece of cloth or paper 1 metre square to use as a guide.
8. Have estimating contests. Students can use their personal reference points for cm, dm, and m to estimate areas, too. An estimate within 20% is very good.

Volume (Capacity)

1. Have students use centimetre cubes to fill up small boxes and count how many it takes. The answer in each case is the volume of the box. This concept is the essence of volume measurement. Remember, 1 cubic centimetre = 1 millilitre ($1\ cm^3 = 1\ ml$).
2. Fold square centimetre grid paper or tagboard to make boxes which are 100 cubic centimetres, 250 cubic centimetres, 500 cubic centimetres, and 1000 cubic centimetres or 1 litre. Suggested dimensions in centimetres are 5x5x4, 5x5x10, 10x10x5, and 10x10x10. Also have children fill these boxes with centimetre cubes to find the volumes. Subsequently, guide them to discover the multiplication rule for determining volumes of rectangular boxes.
3. Have students use clear plastic cups or paper cups to make their own 250 millilitre graduated cylinders. See the section on equipment for directions.
4. Have children search at home to find jars, cans, or other containers which have capacities of about 100, 250, and 1000 millilitres.

5. Have children put a group of irregularly shaped containers in order of increasing volume—by sight. Then check by measuring the capacities.
6. Have students select from among several containers the ones which have given capacities—e.g. 50 *ml*, 100 *ml*, 250 *ml*, 500 *ml*, 1000 *ml*.
7. Have estimating contests. Give students several containers and have them estimate the capacities. Check to see who is closest. An estimate within 30% is very good.
8. Have students make a cubic metre. Measure to see how many would fit into the classroom.

Weight (Mass)

1. Use paper clips to make sets of small metric weights and then baggies and sand to make larger weights. See equipment section for construction details.
2. Have students search for items in the classroom and at home which have masses of about 1 g, 10 g, 100 g, 500 g, and 1000 g or 1 kg.
3. Get a bathroom scale and relabel it in kilograms, using the rule 11 pounds = 5 kg. Have children weigh themselves. Repeat throughout the year and keep graphs.
4. Have students find the masses of standard U.S. coins. You will need a precise balance for this.
5. Collect a random group of objects ranging in mass from 10 g to 500 g. Have children arrange them in order of increasing mass. Check by weighing.
6. Fill a litre container with water and use a pan balance to show that the contents weigh about 1 kilogram. The contents won't weigh exactly 1 kg because of the water temperature, the impurities in the water, etc.
7. From a collection of objects, have students select ones which they think have given masses—such as 50 g, 100 g, 250 g, 500 g, and 1 kg.
8. Have an estimating contest. Have students estimate the masses of various objects. An estimate within 40% is good.

Temperature

1. Compare indoor temperature with outdoor temperature. Repeat throughout the year, record, and graph.

2. Compare the temperature in the sun with the temperature in the shade.
3. Compare the temperature near a window inside the room with the temperature away from the window—but not near a heater.
4. Find normal body temperatures.
5. Find the temperature of water from the cold water faucet, the hot water faucet, and the drinking fountain (be sure your thermometer registers temperatures to at least 60°C).
6. Make a mixture of ice cubes and water and find the temperature. Add salt to the ice cube and water mixture and stir. Find the temperature. Relate results to making homemade ice cream.
7. Put a thermometer inside a car sitting in the sun. Read the temperature after an hour or two.
8. Use a thermometer which registers at least 110°C. Put it into boiling water and find the temperature.
9. Have students select correct temperatures for selected events—e.g. skiing -5°C, swimming 25°C.

-5°C

25°C

Metrics in special areas

Although the activity approach to teaching metrics can be used successfully with almost any audience, there are several groups which merit special attention.

Adult Education

Parents of school children, adult basic education students, business and industry personnel, senior citizens, and all other adults in the community must be included in metric education efforts. The task of educating the adult public about the metric system will be doubly difficult since they are already accustomed to the traditional system and are naturally reluctant to change to an unfamiliar system.

Adult audiences must first be convinced that they are able to easily master the portion of the metric system that will affect their daily lives. The activity approach used with children can be adapted to be equally effective with adults, since actual involvement and practice in using the new units have a greater impact than listening to a lecture.

With practice, the simplicity of using the metric system will become evident along with its many other advantages. To facilitate the transition both school children and the adult segment of the population must be taught the advantages as well as the measurement skills necessary in everyday life.

Business Education

Students preparing for occupations via the business education route should recognize the necessity of an awareness of and proficiency in the metric system. Why? Everyone is involved daily in the use of weights and measures as consumers and producers. Consider, for example, a simple invoice or an order blank where one must learn to substitute metric terms for the traditional pounds, gallons, feet, and inches.

From top management to the person delivering company mail, we will be required to "think metric!" Secretaries will need to master shorthand symbols for metric terms, typists will leave margins measured in centimetres, accountants will keep records of litres of gasoline used in company vehicles, and space management in the office will be concerned with square metres of space per employee.

Exciting? Yes! And YOU are an active participant in one of the most revolutionary changes in our history. Business and industry are actively involved in the change. For further information on how you can be part of the revolution, contact the Center for Metric Education, Morehead State University, Morehead, KY 40351.

Education for Exceptional Children

Teaching metrics to an exceptional child requires first looking at the nature of the child's handicapping condition prior to determining the best teaching strategy (i.e. auditory, visual, tactile, kinesthetic, olfactory, or combination of these) that should be used. This will insure that the child is not handicapped further by the method of instruction, and will enable him to achieve his learning potential. However, the following suggestions would be most acceptable and profitable when teaching metrics to any student.

The use of manipulative aids is a must. In order to fully grasp a particular concept, it is imperative that some type of concrete association be made by the student. The concrete level of learning is the most basic, so we must start here with all students, and perhaps dwell a bit longer with exceptional children.

Another point to consider when working with exceptional children is that teaching activities should occur in smaller doses than with the so-called "normal child." Exceptional children may not be able to assimilate information if it is presented in an extended lesson or is too large a dose.

For specific information in this area, contact any of the categorical division directors, Bureau of Education for Exceptional Children, Kentucky Department of Education, Frankfort, KY 40601

Home Economics

Metrication will soon be an integral part of consumer and homemaking education. Child care students will determine that a new born baby weighs 3 kilograms and is 49 centimetres long. Clothing and textiles students will figure that a girl measuring 87-66-92 will need 2.4 metres of fabric and a 20-centimetre zipper to make a dress. The study of food and nutrition will include practice in measuring 250 millilitres of milk and 6 grams of salt, and figuring the cost of serving potatoes at $.20 per kilogram.

Housing students will determine the number of square metres of carpet needed for the living room. The cost of operating an appliance at $.5 per kilowatt hour or driving a car which gets 6 kilometres per litre of gasoline will be calculated by students in management and consumer education. The study of health in personal and family development will reveal that normal body temperature is 37°C and weight watchers will be counting kilojoules.

The home economics teacher who needs help in converting to metrics may contact the local County Extension Office, or the Home Economics Unit, Bureau of Vocational Education, Kentucky Department of Education, Capital Plaza Tower, Frankfort, KY 40601.

Industrial Education

Most of industry is just beginning the conversion to metrics. With the exception of the electricity/electronics area which is already using the metric system, each industrial teaching area will experience change. Automotive, drafting, and manufacturing are well on their way to metric conversion. Many automotive products are now in metric sizes. Most drawings in industry are now dual-dimensioned in the metric and English systems. Many manufacturing industries are now producing products in metric sizes. The printing and construction industries are making the conversion more slowly; however, much of the equipment in these industries is dual-dimensioned.

It is important to keep abreast of all the changes in each teaching area in metrics and to keep the program current. The following area suggestions on how to accomplish this task.

1. Read your professional journals and periodicals.
2. Your advisory committee should make you aware of any new developments, metric and otherwise, in the files.
3. Choose carefully the metric tools and equipment that will best help the student understand metrics in your program.
4. Your local coordinator or instructional supervisor can help you with resources on general metric topics. You may want to contact other teachers in your district who may be teaching metrics.
5. Become familiar with metrics in general in order to understand the full impact metrics will have in this country.
6. The Bureau of Vocational Education has metric consultants in each program area and by writing to either the Practical Arts Unit or Industrial Education Unit, metric assistance can be obtained.

Materials you will need

Materials to teach the metric system need not cost a great deal since existing materials can easily be transformed by involving students in making some of the adaptations. For example, if students cover conventional rulers with masking tape and then relabel them with metric units, not only will money be saved but also a tremendous amount of learning will occur. Some money will have to be spent for items that require precision, such as pan balances, but these items can be shared by a number of teachers.

The list below describes the purchase and construction of items which are useful for teaching the metric system to a class of about thirty students.

1. Ten unmarked metre sticks (cost $.20 each)
   Screen molding ¾-inch wide can be purchased for about $.06 per foot and cut into metre lengths.

2. Five decimetre-band metre sticks (cost $.30 each)
   Use the ¾-inch screen molding cut into 1-metre lengths. First cover the flat side with ¾-inch black electrical tape. Then cut five 1-decimetre strips of ¾-inch yellow plastic tape and place it on top of the black tape leaving 1-decimetre intervals of black tape showing. Do not put any numerals on the stick.

3. Five centimetre-band metre sticks (cost $.30 each)
   Adhesive centimetre tape can be purchased from school supply houses and then affixed to 1-metre lengths of ¾-inch screen molding or to 1 1/8-inch lattice board. Again, no numbers please.

4. Ten 20-centimetre rulers (cost $.08 each)
   Cut adhesive centimetre tape into 20-centimetre lengths and affix them to 20-centimetre lengths of screen molding or lattice board. One could also lay a centimetre ruler beside a blank section of molding and copy the ruler markings onto the molding.

5. Ten centimetre-band measuring tapes (free)
   From any store that sells window shades, obtain the shade portion that is discarded after the shade is cut to fit the width of the customer's window. Cut each into 1-metre lengths that are about 2 centimetres wide. Then label each in centimetres with a permanent marker.

6. One 200-centimetre height chart (cost $.30)
   Use two centimetre-band metre sticks (item 3) and tape them to a wall or use a 2 metre length of buckram from a fabric store and label it in centimetres.

7. One hundred decimetre rods (cost $5.00 per 100)
These rods are very useful for length, area, and volume activities.

8. One-thousand cubic centimetre cubes (cost $19.00 per 1000)
These cubes are very useful for length, area, and volume activities.

9. Two plastic metric trundle wheels (cost $12.50 each)
Plastic trundle wheels with rubber edges work exceedingly well for measuring distances in metres.

10. Two sheets of clear square centimetre grids (cost $.90 each)
These grids can be placed on top of figures and then the areas of those figures can be counted in square centimetres.

11. Ten 250-millilitre graduated cylinders (cost $.10 each)
Make these by using clear plastic cups (10 ounce) and permanent markers. Measure 25 millilitres of water into a commercial graduated cylinder and then pour it into an empty cup; mark the level. Add 25 millilitres more and mark. Repeat until 250 millilitres level is reached.

12. Ten cubic decimetre boxes (free)
Use posterboard or cardboard to make five 1-decimetre squares. Tape the edges together to make an open box that has a capacity of 1 cubic decimetre or 1 litre.

13. One set of metric weights (cost $15.00 per set)
One set of metric masses can be used as a model for making duplicate sets cheaply.

14. Five sets of large metric weights (cost $.15 each)
Use a pan balance, sand, baggies, and a model set of masses (item 13) to make a set of metric masses—50 g, 100 g, 500 g. Make about 5 of each size.

15. Five sets of small metric weights (cost $.05 each)
Use a pan balance, paper clips, wire cutters, and a model set of masses (item 13) to make a set of small metric masses—1 g, 5 g, 10 g, 20 g. Make about 5 of each.

16. One pan balance (cost $25. each)
These may already be in science rooms in many schools.

17. One cubic metre frame (cost $15.00 each)
It is possible to make a cubic metre from 12 metre sticks—but the results are very frustrating. The commercial "tinkertoy" type cubic metre frame works nicely.

18. Five Celsius-only thermometers--range from -20°C to 50°C (cost $1. each)
    These thermometers work well for mosf activities, but don't put them in water that's hotter than your bath water--they will break!

19. One Celsius-only thermometer--range from -20°C to 110°C (cost $5 each)
    This item may not be available at all school supply houses, but with perseverance it can be found.

Kentucky State Board of Education Resolutions on Metric Instruction

WHEREAS
The metric measurement standards recognized and developed by the International Bureau of Weights and Measures have been adopted as the fundamental measurement standards of the United States; and

WHEREAS
The customary units of weights and measures used in the United States have, since 1893, been based upon such metric measurement standards; and

WHEREAS
Ninety percent of the world's population is using the metric system, and more than eighty percent of the world's production and trade is measured in metric units; and

WHEREAS
The Congress finds that the metric system of measurement is in general use in industrially developed nations and its use is increasing; and

WHEREAS
The increased use of such a metric system in the United States is inevitable, and such a metric system will become the dominant system of weights and measures in the United States; and

WHEREAS
The National Education Association has resolved that teachers of all grades should teach the metric system to assure, as a national goal, the orderly transition to the use of the metric system as a primary system by 1980; and

WHEREAS
The National Conference of Weights and Measures has resolved that all State Departments of Education follow the recommendations of the National Education Association;

BE IT THEREFORE RESOLVED THAT:

Commencing with the 1976-1977 school year and thereafter, all schools subject to the rules and regulations of the State Board of Education shall provide instruction in the International Metric System of Measurement. Such instruction may be in addition to the present instruction concerning the system of weights and measures in the schools on the effective date of this resolution; provided, however, that the International Metric System of Weights and Measures shall be given the major emphasis beginning with the 1980-81 school year.

BE IT FURTHER RESOLVED THAT:

The State Board of Education endorses in principle the recommendations that were adopted by the Interstate Consortium on Metric Education on October 3, 1974.

For more information

American Association of School Librarians
50 East Huron Street
Chicago, Illinois 60611

American Home Economics Association
2010 Massachusetts Avenue, N.W.
Washington, D.C. 20036

American Institutes for Research
Metric Studies Center
P.O. Box 1113
Palo Alto, California 94302

American National Metric Council
1625 Massachusetts Avenue, N.W.
Washington, D.C. 20036

American National Standards Institute
1430 Broadway
New York, New York 10018

Canadian Metric Association
P.O. Box 35
Fonthill, Ontario
Canada LOS IEO

Canadian Standards Association
178 Rexdale Boulevard
Rexdale, Ontario
Canada M9W IR3

General Motors Corporation
Argonaut Building A203
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J.C. Penney Company, Inc.
1301 Avenue of the Americas
New York, New York 10019

Ms. Joan Koenig
National Bureau of Standards
U.S. Department of Commerce
Washington, D.C. 20234

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Sugarloaf Star Route
Boulder, Colorado 80302

Metric Commission
320 Queen Street
Ottawa, Canada KIA OH5

National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22091

National Education Association
1201 16th Street, N.W.
Washington, D.C. 20036

National Science Teachers Association
1742 Connecticut Avenue
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